US008783210B2

(12) **United States Patent**
Takayama

(10) **Patent No.: US 8,783,210 B2**
(45) **Date of Patent: Jul. 22, 2014**

(54) **ROBOT COATING SYSTEM**

(71) Applicant: **FANUC Corporation**, Yamanashi (JP)

(72) Inventor: **Yuusake Takayama**, Yamanashi (JP)

(73) Assignee: **FANUC Corporation**, Minamitsuru-gun, Yamanashi (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/834,174**

(22) Filed: **Mar. 15, 2013**

(65) **Prior Publication Data**

US 2013/0284088 A1 Oct. 31, 2013

(30) **Foreign Application Priority Data**

Apr. 26, 2012 (JP) 2012-101332

(51) **Int. Cl.**
B05B 3/00 (2006.01)
B05C 11/10 (2006.01)

(52) **U.S. Cl.**
USPC **118/683**; 118/696; 118/323; 118/321; 901/43; 700/23

(58) **Field of Classification Search**
CPC B05B 13/04
USPC 118/321, 323, 683, 695–699; 901/43; 700/123; 427/427.2, 427.3, 8; 239/587.1, 587.5
See application file for complete search history.

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	04-322986		11/1992
JP	07-080376		3/1995
JP	3522329	B	11/1995
JP	09-182947		7/1997
JP	10-000398		1/1998
JP	3961820	B	6/2003
JP	2004-321852	A	11/2004
JP	2006-075699	A	3/2006
JP	2011-011139	A	1/2011

Primary Examiner — Yewebdar Tadesse
(74) *Attorney, Agent, or Firm* — Drinker Biddle & Reath LLP

(57) **ABSTRACT**

A robot coating system (**1**) includes a robot moving unit (**21**) which makes a robot (**11**) having a coating gun (**12**) successively move to a plurality of planned coating positions, a readying pressure imparting unit (**22**) which drives a pump (**13**) of the coating gun before reaching the planned coating positions and imparts to the viscous material a predetermined readying pressure without coating the viscous material, a coating executing unit (**23**) which executes coating work of the viscous material by a predetermined flow rate over a predetermined coating time when the coating gun has reached a planned coating position, and a post-coating stopping unit (**24**) which continues the coating work to make the pump stop after the end of the work when executing the coating work and a stop command of the robot is issued.

4 Claims, 10 Drawing Sheets

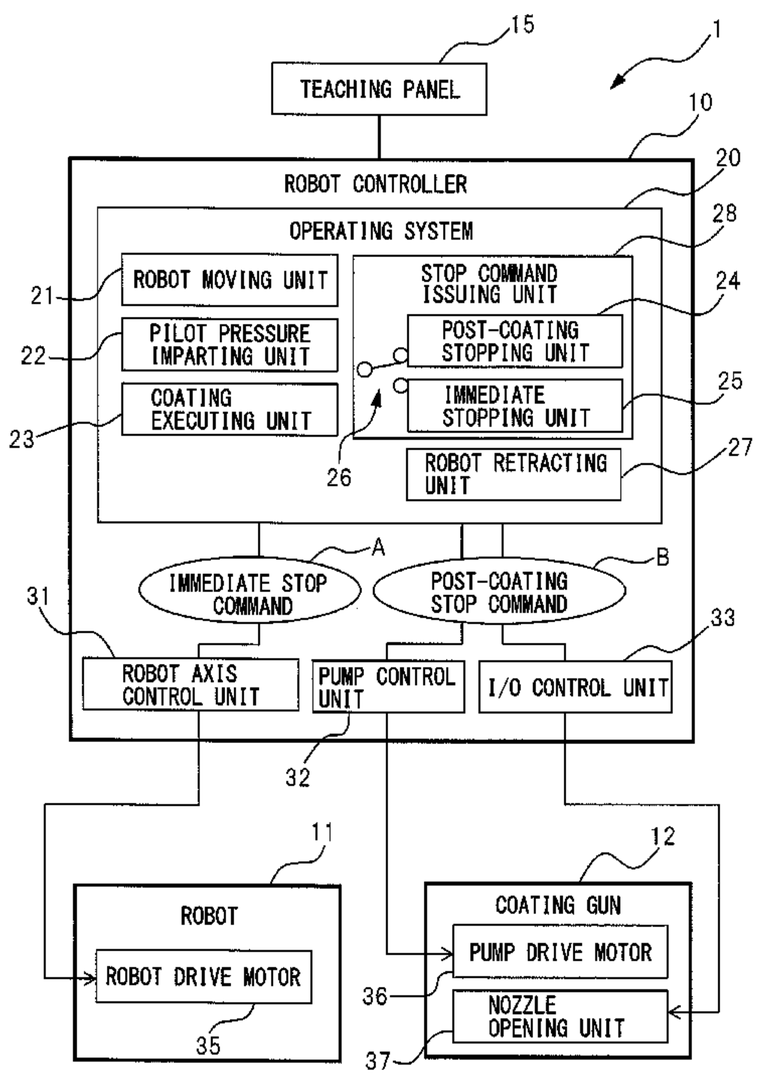

FIG. 1

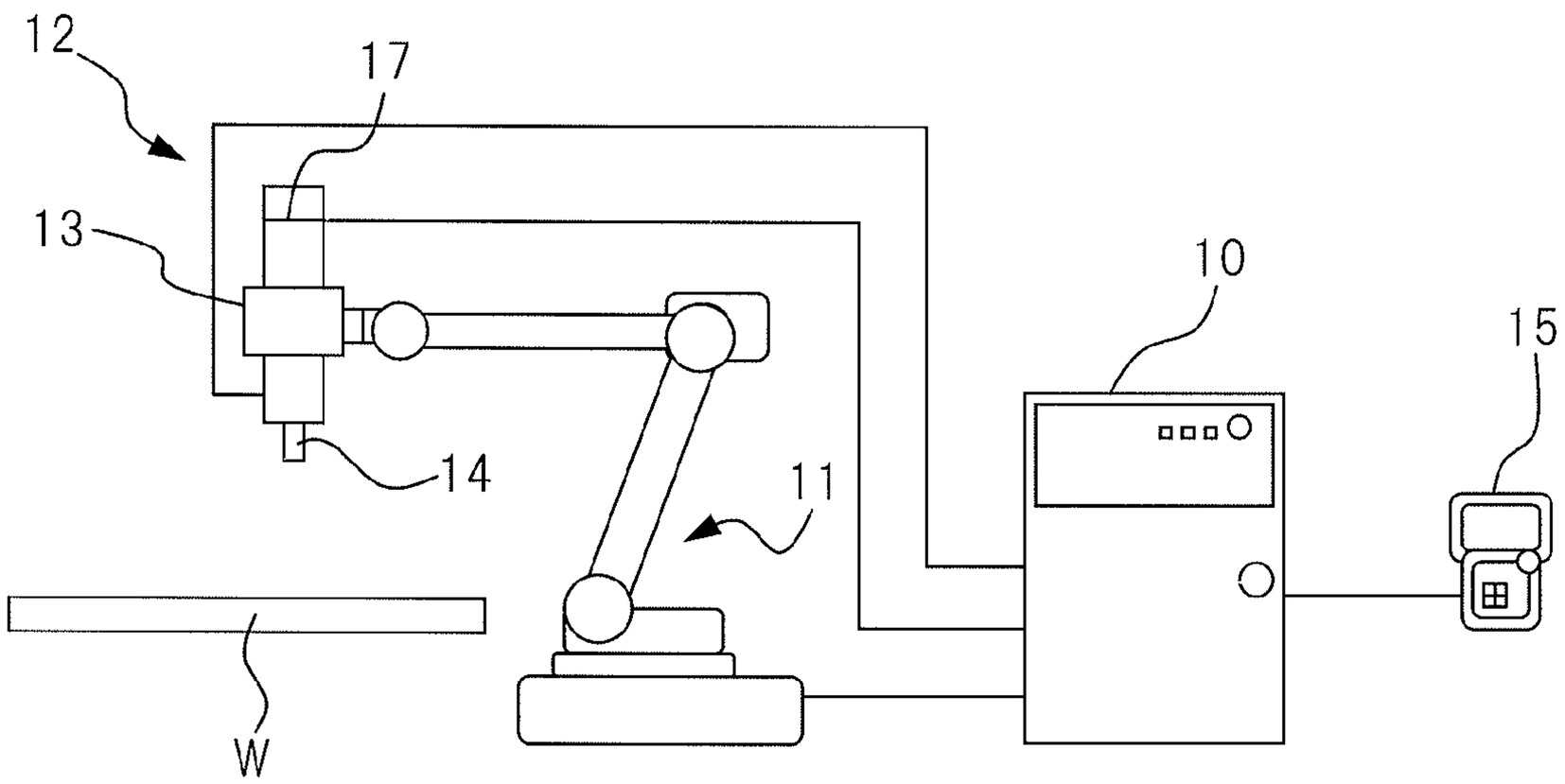

FIG. 2

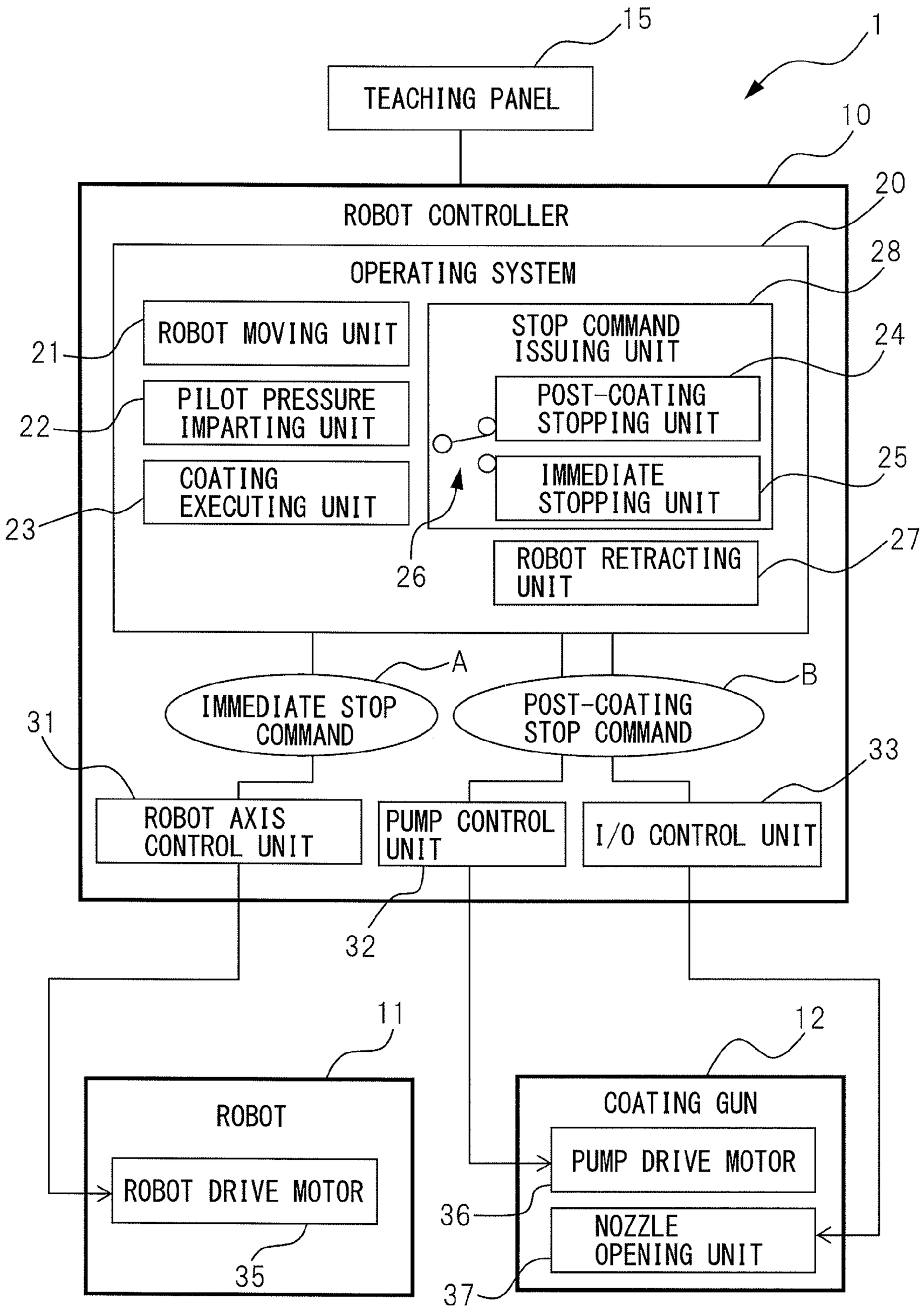
15
TEACHING PANEL
1
10
ROBOT CONTROLLER
20
OPERATING SYSTEM
28
21
ROBOT MOVING UNIT
STOP COMMAND ISSUING UNIT
24
22
PILOT PRESSURE IMPARTING UNIT
POST-COATING STOPPING UNIT
25
23
COATING EXECUTING UNIT
IMMEDIATE STOPPING UNIT
26
27
ROBOT RETRACTING UNIT
A
B
IMMEDIATE STOP COMMAND
POST-COATING STOP COMMAND
31
33
ROBOT AXIS CONTROL UNIT
PUMP CONTROL UNIT
I/O CONTROL UNIT
32
11
12
ROBOT
COATING GUN
ROBOT DRIVE MOTOR
PUMP DRIVE MOTOR
36
NOZZLE OPENING UNIT
35
37

FIG. 3

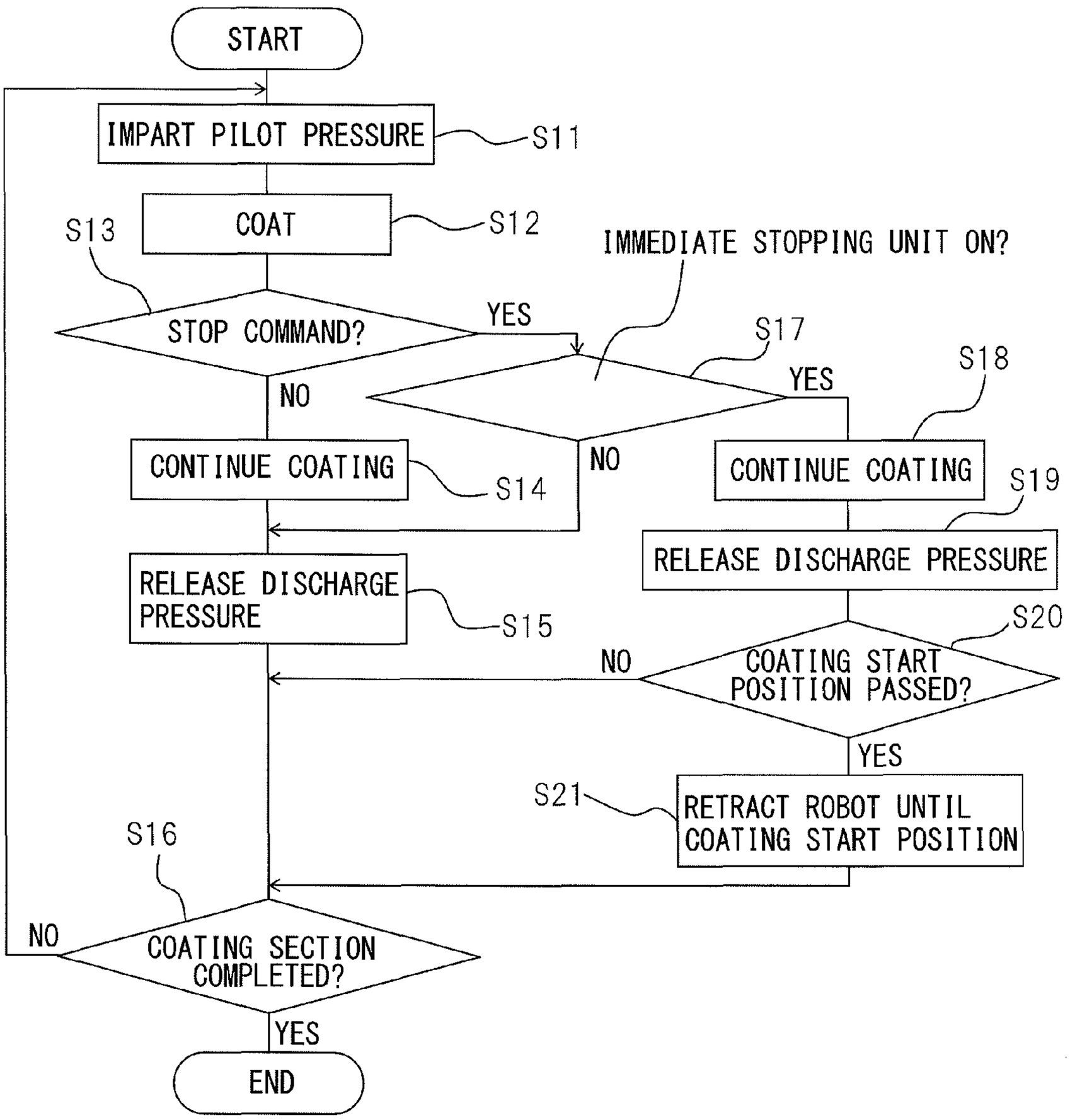
START
IMPART PILOT PRESSURE
S11
COAT
S12
S13
STOP COMMAND?
YES
NO
IMMEDIATE STOPPING UNIT ON?
S17
YES
NO
S18
CONTINUE COATING
S14
CONTINUE COATING
S19
RELEASE DISCHARGE PRESSURE
RELEASE DISCHARGE PRESSURE
S15
S20
NO
COATING START POSITION PASSED?
YES
S21
RETRACT ROBOT UNTIL COATING START POSITION
S16
NO
COATING SECTION COMPLETED?
YES
END

FIG. 4

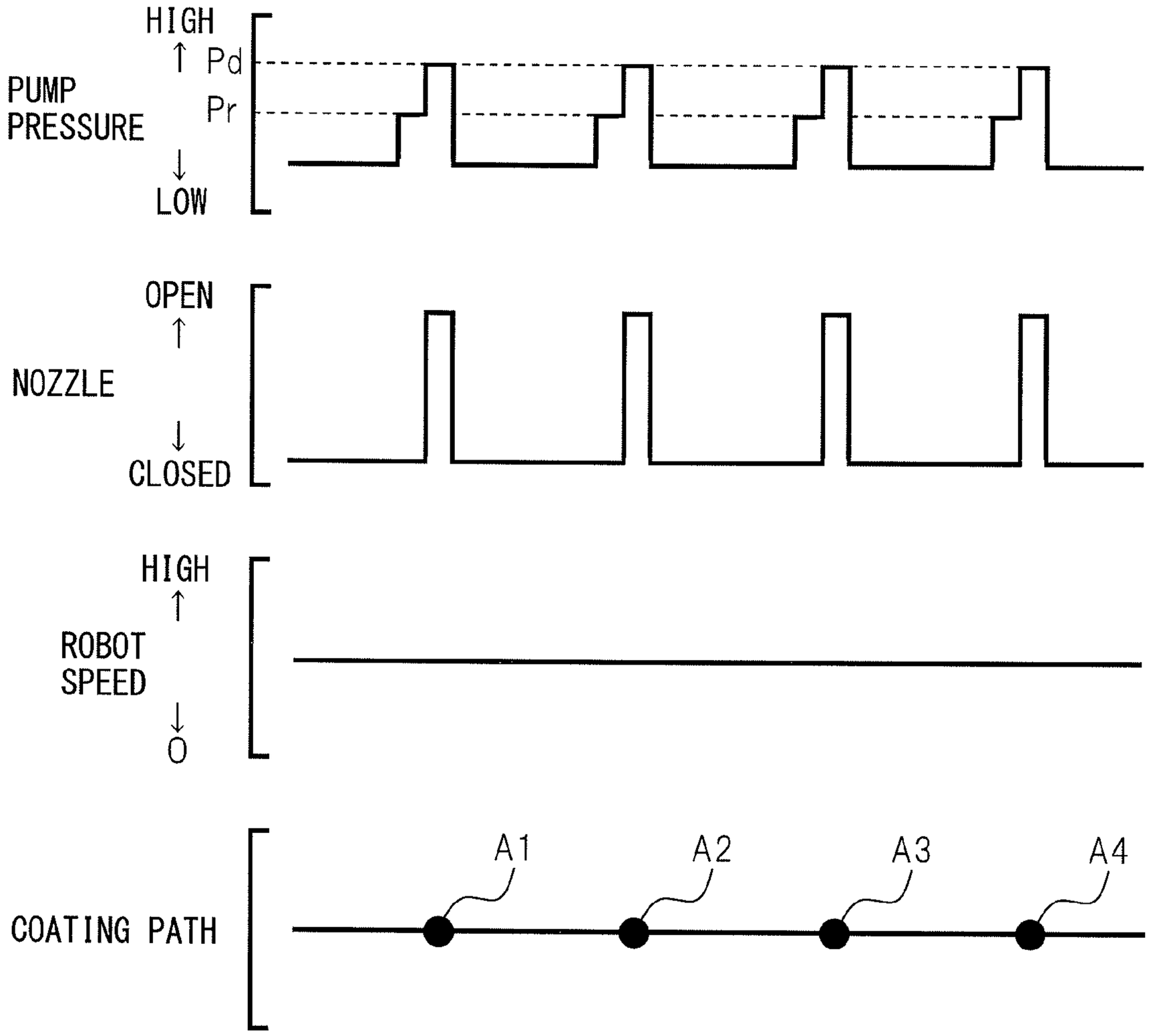
HIGH
Pd
PUMP PRESSURE
Pr
LOW
OPEN
NOZZLE
CLOSED
HIGH
ROBOT SPEED
0
COATING PATH
A1
A2
A3
A4

FIG. 5

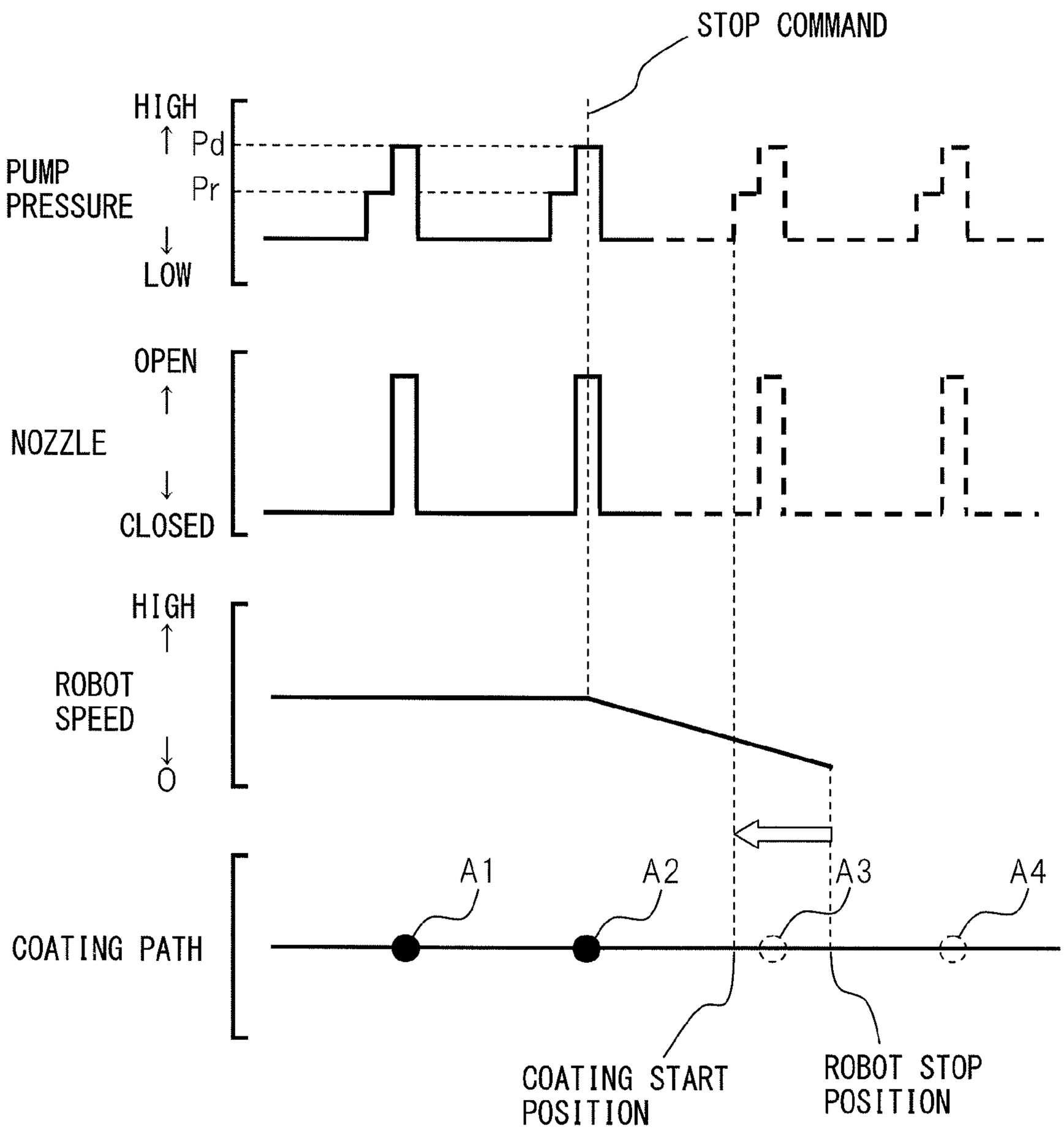
STOP COMMAND
HIGH
Pd
Pr
PUMP PRESSURE
LOW
OPEN
NOZZLE
CLOSED
HIGH
ROBOT SPEED
0
A1
A2
A3
A4
COATING PATH
COATING START POSITION
ROBOT STOP POSITION

FIG. 6

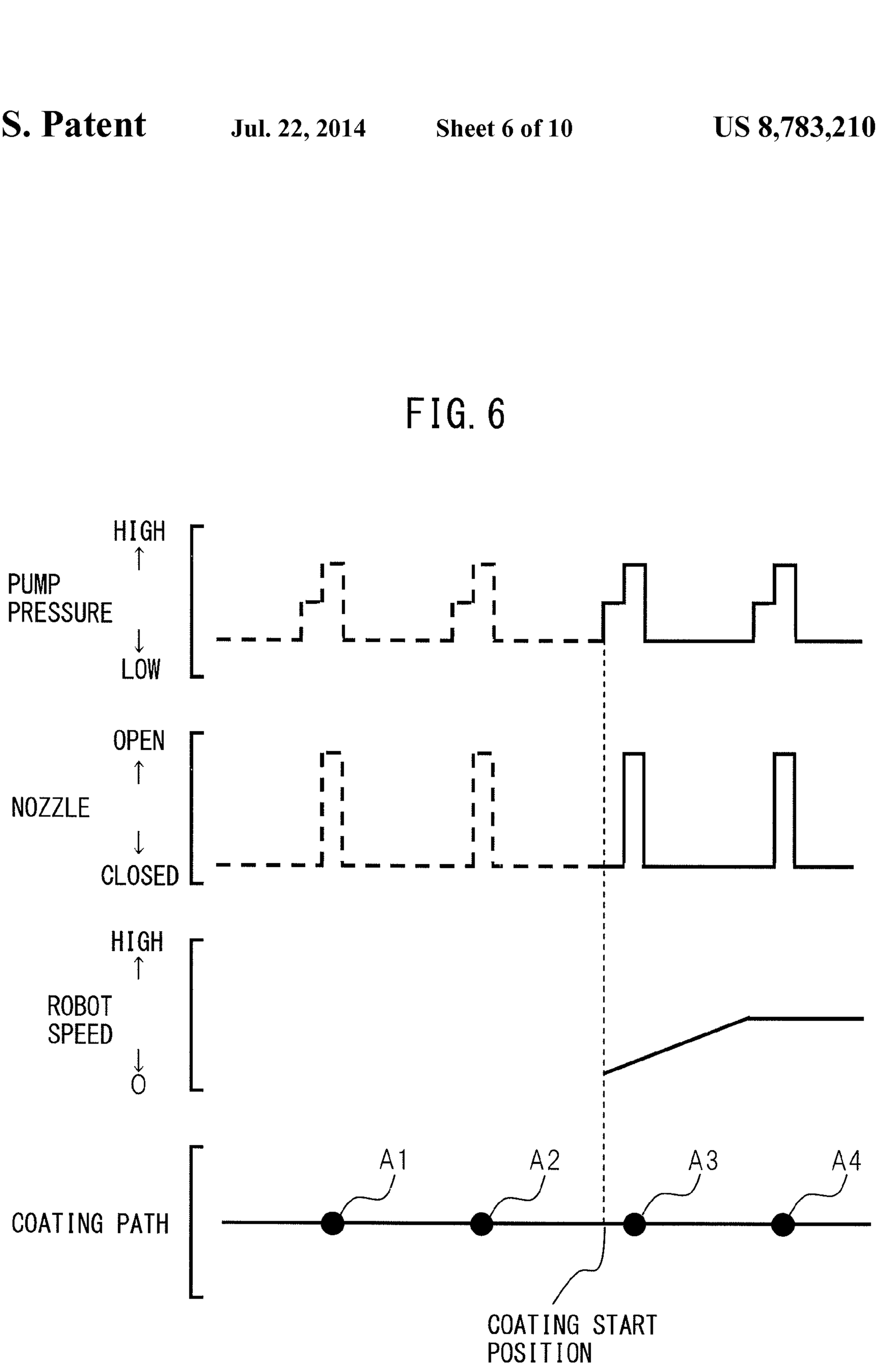
HIGH
PUMP PRESSURE
LOW
OPEN
NOZZLE
CLOSED
HIGH
ROBOT SPEED
0
A1
A2
A3
A4
COATING PATH
COATING START POSITION

FIG. 7

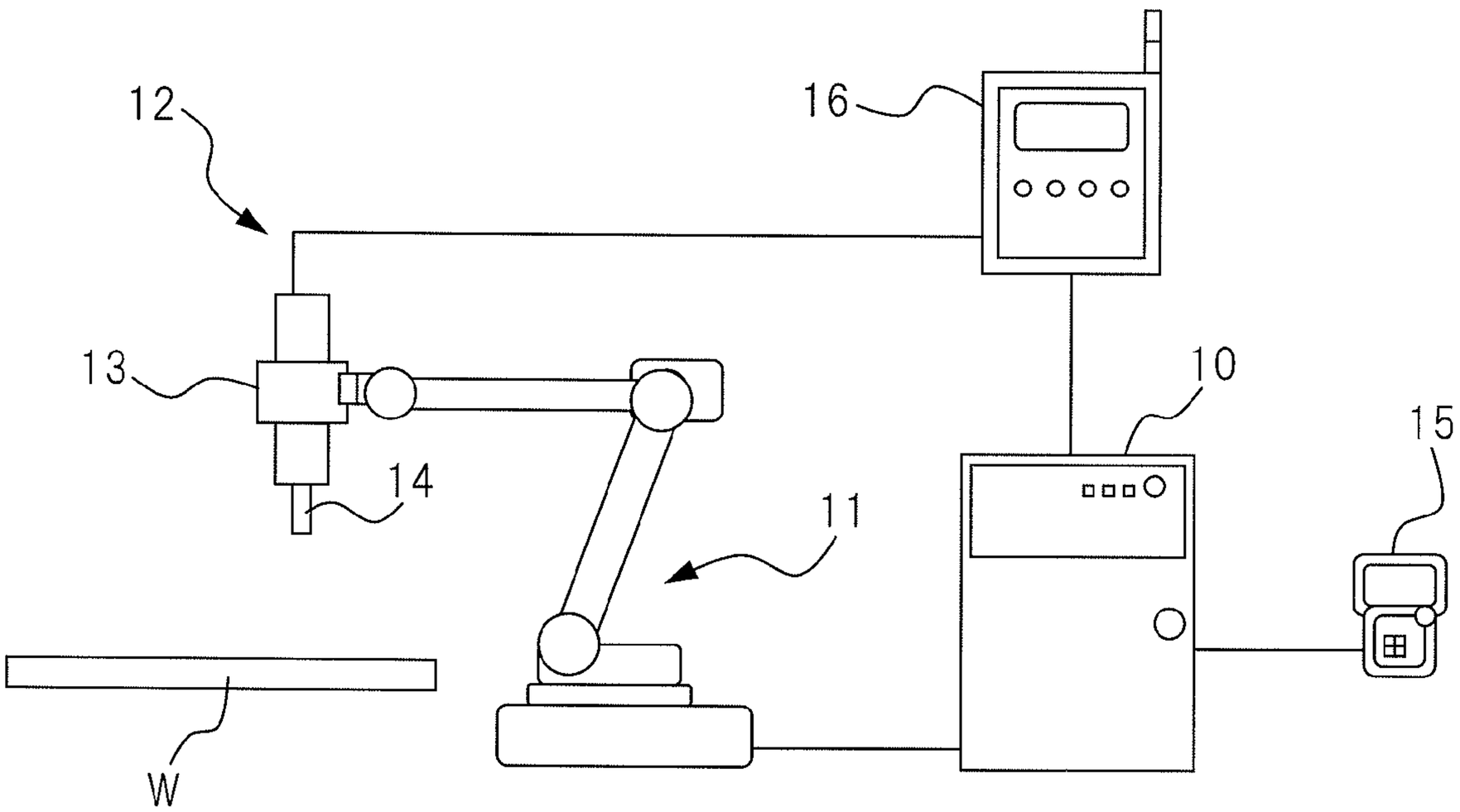

FIG. 8

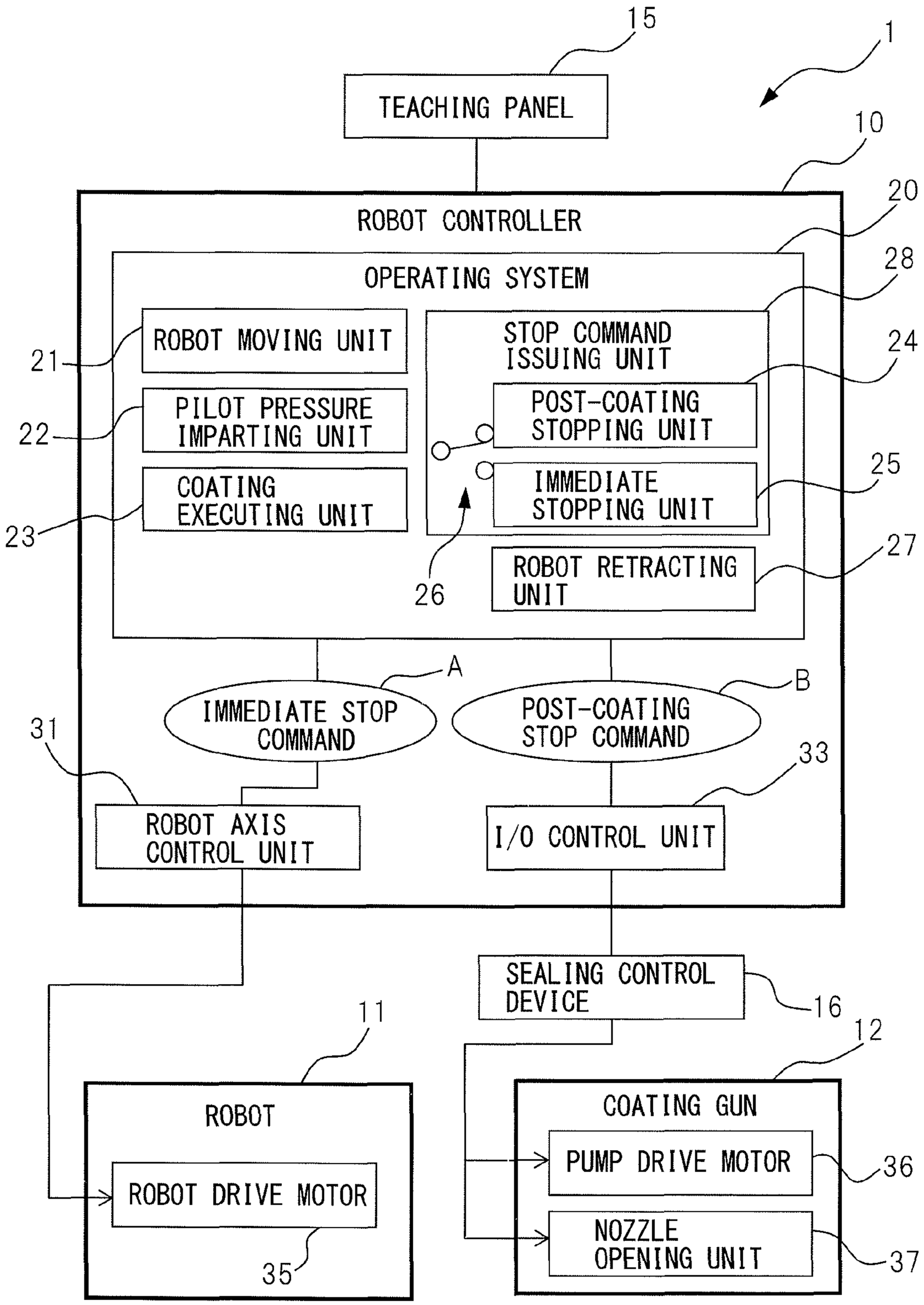
15
TEACHING PANEL
1
10
ROBOT CONTROLLER
20
OPERATING SYSTEM
28
ROBOT MOVING UNIT
21
STOP COMMAND ISSUING UNIT
24
PILOT PRESSURE IMPARTING UNIT
22
POST-COATING STOPPING UNIT
COATING EXECUTING UNIT
23
IMMEDIATE STOPPING UNIT
25
26
ROBOT RETRACTING UNIT
27
A
B
IMMEDIATE STOP COMMAND
POST-COATING STOP COMMAND
31
33
ROBOT AXIS CONTROL UNIT
I/O CONTROL UNIT
SEALING CONTROL DEVICE
16
11
12
ROBOT
COATING GUN
ROBOT DRIVE MOTOR
PUMP DRIVE MOTOR
36
NOZZLE OPENING UNIT
35
37

FIG. 9

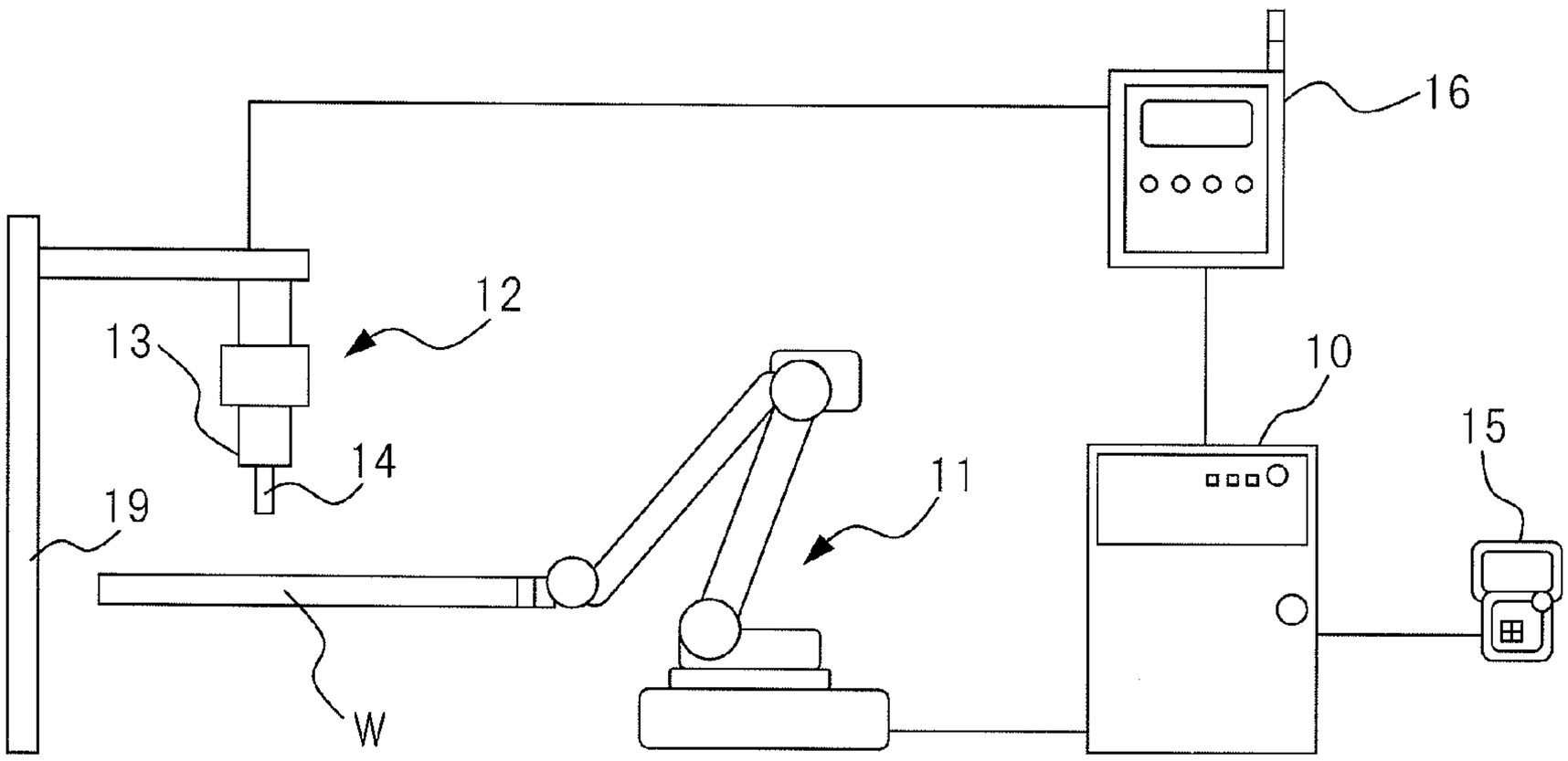

FIG. 10

COATING CONDITION	#1
FLOW RATE	1cc/sec
NOZZLE OPENING TIME	50msec
PILOT PRESSURE RATE	50%
PILOT PRESSURE TIME	50msec

FIG. 11

POSITION[1]	1000mm/sec	SMOOTH	100 SS[1]
POSITION[2]	1000mm/sec	SMOOTH	100 SS[1]
POSITION[3]	1000mm/sec	SMOOTH	100 SS[1]

ROBOT COATING SYSTEM

RELATED APPLICATION DATA

This application claims priority under 35 U.S.C. §119 and/or §365 to Japanese Application No. 2012-101332 filed Apr. 26, 2012, the entire contents of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a robot coating system which includes a robot which is provided with a coating gun which uses a pump to coat a viscous material and by which the coating gun coats a plurality of planned coating positions on a workpiece with a viscous material in exactly predetermined amounts to thereby scatter coat the viscous material.

2. Description of the Related Art

An industrial robot, for example, a multiarticulated robot, which coats a viscous material includes a coating gun which is attached to the tip of the robot arm. The coating gun is provided with a pump. If driving the pump, the nozzle of the coating gun discharges a viscous material, for example, a paint or sealing material (see Japanese Patent No. 3961820 and Japanese Patent No. 3522329).

In coating work which coats a viscous material, it is necessary to define the start and end positions. A first method provides a robot teaching program in which a coating start position and a coating end position are defined. This method is used for coating work which coats a viscous material by a straight continuous path.

In a second method, a robot is made to temporarily stop at a target position, then the viscous material starts to be coated. Further, when predetermined coating work is completed with a designated coating time and coating speed or coating amount, the robot is made to move to the next target position where the above-mentioned coating work is again performed. This is frequently used in the case of scatter coating which repeatedly coats a plurality of target positions with fixed coating amounts.

In both the above-mentioned first and second methods, when some sort of abnormality occurs at the robot at the time of the robot coating work and an alarm is issued and the robot stopped, the coating gun simultaneously stops. In this case, the coating gun stops before discharging the intended coating amount.

In this connection, the first method designates a coating start position and a coating end position. This is suitable for coating work which coats a viscous material without interruption on a continuous path. However, in the first method, the time which is required from the coating start to coating end is determined in accordance with the content of operation of the robot. Obtaining the time uniquely is extremely difficult.

Further, the amount of coating of the viscous material at the coating gun is determined in accordance with the coating speed, coating time, internal pressure of the viscous material before coating (hereinafter referred to as the "pilot pressure"), etc. Therefore, if using the first method for scatter coating, the coating time is not uniquely determined, so a fixed amount of coating cannot be obtained. Therefore, when coating a sealing material, there is a possibility of variation occurring in the sealing strength. Furthermore, when the coating gun stops, the coating work is interrupted, then the coating work is resumed, it is hard to make the sum of the amount of coating before resumption of the coating work and the amount of coating after resumption strictly match with the intended amount of coating.

Furthermore, in the second method as well, there is a similar problem when the coating gun is stopped, the coating work is interrupted, then the coating work is resumed. In the second method, it is necessary to make the robot stop temporarily at the target position in the coating work, so there is the problem that the cycle time of the robot system increases.

The present invention was made in consideration of this situation and has as its object to provide a robot coating system wherein the amount of coating of the viscous material does not change from the intended coating amount even if the coating work is interrupted and then the coating work is resumed.

SUMMARY OF THE INVENTION

To achieve the above-mentioned object, according to a first aspect, there is provided a robot coating system which includes a robot which is provided with a coating gun which uses a pump to coat a viscous material and in which the coating gun coats a plurality of planned coating positions of a workpiece with the viscous material in exactly predetermined amounts to thereby scatter coat the viscous material, the robot coating system comprising a robot moving unit which makes the robot which is provided with the coating gun successively move to the plurality of planned coating positions at the time of operation of the robot coating system, a pilot pressure imparting unit which drives the pump of the coating gun before reaching the planned coating positions and imparts to the viscous material a predetermined pilot pressure without coating the viscous material, a coating executing unit which executes coating work of the viscous material by a predetermined flow rate over a predetermined coating time when the coating gun has reached a planned coating position or immediately before that, and a post-coating stopping unit which continues the coating work by the coating executing unit and makes the pump stop after the end of the coating work when the coating executing unit is executing the coating work and a command is issued to stop the robot.

According to the second aspect, there is provided the first aspect which comprises an immediate stopping unit which makes the pump stop without continuing the coating work by the coating executing unit when the coating executing unit is executing the coating work and a command is issued to stop the robot and a selection unit which selects one of the post-coating stopping unit and the immediate stopping unit for functioning.

According to the third aspect, there is provided the first or second aspect which further comprises a robot retracting unit which makes the robot retract to at least the coating start position when a stop command of the robot is issued and the robot stops over the coating start position of the planned coating position before coating the viscous material at one planned coating position among the plurality of planned coating positions.

According to the fourth aspect, there is provided any of the first to third aspects which further comprises an input unit which teaches coating conditions of the coating work and a display unit which displays at least one coating condition which is taught from the input unit including a coating time and flow rate of the viscous material and at least one planned coating position.

These objects, features, and advantages of the present invention and other objects, features, and advantages will

become further clearer from the detailed description of typical embodiments of the present invention which are shown in the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic side view of a robot coating system according to a first embodiment of the present invention.

FIG. **2** is a functional block diagram of a robot coating system which is shown in FIG. **1**.

FIG. **3** is a flow chart which shows the operation of a robot coating system according to the present invention.

FIG. **4** is a view which shows a time chart of a pump pressure, nozzle, robot speed, and coating path.

FIG. **5** is a view which shows a time chart of a pump pressure, nozzle, robot speed, and coating path when stopping coating work.

FIG. **6** is a view which shows a time chart of a pump pressure, nozzle, robot speed, and coating path when restarting coating work.

FIG. **7** is a schematic side view of a robot coating system according to a second embodiment of the present invention.

FIG. **8** is a functional block diagram of a robot coating system which is shown in FIG. **7**.

FIG. **9** is a schematic side view of a robot coating system according to a third embodiment of the present invention.

FIG. **10** is a view which shows the coating conditions which are displayed on a teaching panel.

FIG. **11** is a view which shows part of a coating program which is displayed on the teaching panel.

DETAILED DESCRIPTION

Below, the attached figures will be referred to so as to explain the embodiments of the present invention. In the following figures, similar members are assigned similar reference signs. To facilitate understanding, these figures are suitably changed in scale.

FIG. **1** is a schematic side view of a robot coating system according to a first embodiment of the present invention. As shown in FIG. **1**, a robot coating system **1** mainly includes a multiarticulated robot **11** and a robot controller **10** which is connected to the multiarticulated robot **11**. Furthermore, a teaching panel **15** is connected to the robot **11**.

As shown in FIG. **1**, the front end of the robot **11** is provided with a coating gun **12**. The coating gun **12** is positioned by the robot **11**. The coating gun **12** includes a pump **13** which pumps a viscous material, for example, a paint, sealing material, or adhesive, and imparts a predetermined pilot pressure to the viscous material, a nozzle **14** which is controlled to open and close by the robot controller **10**, and an additional robot shaft **17**.

The additional robot shaft **17** is controlled so as to be synchronized with a servo motor of the robot **11** and drives the pump **13**. When imparting a predetermined pilot pressure to the viscous material, the nozzle **14** is closed while the pump **13** is driven. Further, when coating a viscous material on a workpiece, the pump **13** is driven while the nozzle **14** is opened.

FIG. **2** is a functional block diagram of the robot coating system which is shown in FIG. **1**. As shown in FIG. **2**, the robot controller **10** includes an operating system **20**, robot axis control unit **31**, pump control unit **32**, and I/O control unit **33**.

Further, as shown in FIG. **2**, the robot axis control unit **31** controls a plurality of robot drive motors **35** which are provided at the robot **11**. Similarly, the pump control unit **32** controls a pump drive motor **36** which drives the pump **13** of the coating gun **12**. Furthermore, the I/O control unit **33** controls a nozzle opening unit **37** which opens and closes the nozzle **14** of the coating gun **12**.

Further, the operating system **20** of the robot controller **10** includes a robot moving unit **21** which makes the robot **11** move successively to a plurality of planned coating positions on a workpiece W, a pilot pressure imparting unit **22** which drives the pump **13** of the coating gun **12** to impart to the viscous material a predetermined pilot pressure without coating the viscous material before reaching the planned coating position, and a coating executing unit **23** which executes coating work of the viscous material by a predetermined flow rate over a predetermined coating time when the coating gun **12** reaches the planned coating positions or right before that.

Furthermore, the operating system **20** of the robot controller **10** includes a stop command issuing unit **28** which issues a stop command of a robot **11**. The stop command issuing unit **28** prepares a stop command which makes the robot **11** stop when the robot **11** contacts a peripheral device (not shown) at the time of operation of the robot **11**, when the viscous material which should be supplied runs out, when the load applied to the robot drive motor **35** or pump drive motor **36** is larger than the respective threshold value, or when another abnormality occurs.

As shown in FIG. **2**, the stop command issuing unit **28** includes a post-coating stopping unit **24** which continues the coating work by the coating executing unit **23** and makes the pump **13** stop after the end of the coating work when coating work is being executed and a stop command of the robot **11** is issued and an immediate stopping unit **25** which makes the pump **13** stop without continuing the coating work by the coating executing unit **23** when the coating executing unit **23** is coating the viscous material and a stop command of the robot **11** is issued. The selection unit **26** of the stop command issuing unit **28** is used to select whether to issue a post-coating stop command B from the post-coating stopping unit **24** or to issue an immediate stop command A from the immediate stopping unit **25**.

However, it should be noted that regardless of the selected content of the selection unit **26**, an immediate stop command A is sent to a later explained robot axis control unit **31**. An immediate stop command A or a post-coating stop command B are sent to a later explained pump control unit **32** and I/O control unit **33** in accordance with the selected content of the selection unit **26**.

Further, the operating system **20** includes a robot retracting unit **27** which makes the robot **11** retract to at least the coating start position when a stop command of the robot **11** is issued before coating a viscous material at one planned coating position among a plurality of planned coating positions and the robot **11** passes the coating start position of the planned coating position.

Further, the teaching panel **15** performs the role as an input unit by which an operator instructs the coating conditions of coating work to the robot **11**. The taught contents are supplied to the robot controller **10**. Furthermore, the teaching panel **15** performs the role as a display unit which displays the taught coating conditions and the planned coating position.

Here, FIG. **3** is a flow chart which shows the operation of a robot coating system according to the present invention. The operation which is shown in FIG. **3** is performed repeatedly every predetermined time shorter than the coating time for coating one planned coating position with the viscous material.

Further, FIG. **4** and FIG. **5** is a view which shows time charts of the pump pressure, nozzle, robot speed, and speed

path. In FIG. **4** and FIG. **5**, a plurality of planned coating positions are arranged at equal intervals on a coating path. However, a plurality of planned coating positions may be arranged at different intervals on the coating path. Below, referring to these drawings, the coating work of a viscous material by the robot coating system **1** will be explained.

Note that, in the following explanation, the explanation is given of the case where the workpiece W is fastened at a predetermined position and the robot **11** makes the coating gun **12** move for scatter coating of the viscous material. Here, "scatter coating" means spraying a plurality of planned coating positions predetermined on a straight or curved path with a viscous material in exactly predetermined amounts. Therefore, the operation which is shown in FIG. **3** is executed by the robot moving unit **21** making the robot **11** which is provided with the coating gun **12** successively move by a constant speed to a plurality of planned coating positions on the workpiece W.

First, at step S**11** of FIG. **3**, the pilot pressure imparting unit **22** closes the nozzle **14** through the nozzle opening unit **37** while driving the pump **13** through the pump drive motor **36**. Due to this, as shown in FIG. **4**, the viscous material of the pump **13** is given a predetermined pilot pressure Pr.

Then, at step S**12**, the coating executing unit **23** opens the nozzle **14** through the nozzle opening unit **37** while further drives the pump **13** through a pump drive motor **36**. As a result, as shown in FIG. **4**, the viscous material of the pump **13** is formed with a predetermined discharge pressure Pd. The discharge pressure Pd is larger than the pilot pressure Pr and the nozzle **14** is open, so the viscous material is discharged on the workpiece W from the nozzle **14** of the coating gun **12**.

Further, at step S**13**, it is judged if a stop command issuing unit **28** issues a stop command of the robot **11** on the basis of occurrence of contact of the robot **11** with a peripheral device or another abnormality. If a stop command is not issued, the routine proceeds to step S**14** where the coating work is continued.

As can be seen from FIG. **4**, the opening time of the nozzle **14** and the time during which the discharge pressure Pd of the pump is maintained end generally simultaneously. Due to this, a planned coating position on the workpiece W is coated with exactly a predetermined amount of a viscous material by a predetermined flow rate over a predetermined coating time. In FIG. **4**, the viscous material which is coated on the planned coating position is shown by black circles. In FIG. **5** and the later explained FIG. **6**, a planned coating position which is not yet coated with a viscous material is shown by the broken lines.

If the viscous material is coated in exactly a predetermined amount, at step S**15**, the discharge pressure Pd of the pump is released and the pressure returns to zero. Further, at step S**16**, it is judged if the coating section has ended. In other words, it is judged if there is a planned coating position where viscous material has not been coated. Further, the processing of step S**11** to step S**16** is repeated until the coating work at all planned coating positions is ended.

In this regard, when it is judged at step S**13** that the stop command issuing unit **28** has issued a stop command of the robot **11**, the routine proceeds to step S**17**. At step S**17**, it is judged if the selection unit **26** which is shown in FIG. **2** has selected the immediate stopping unit **25**. When the selection unit **26** is used to select the immediate stopping unit **25**, an immediate stop command A is issued to the pump **13** and the routine proceeds to step S**15** where the discharge pressure Pd is released. Note that, when the immediate stopping unit **25** is selected, this is advantageous for coating the viscous material in a straight continuous path.

As opposed to this, when, at step S**17**, the selection unit **26** is used to select the post-coating stopping unit **24**, the routine proceeds to step S**18**. In this case, a post-coating stop command B is issued to the pump **13** and the coating work at the planned coating position at which the viscous material is currently being coated is continued.

At FIG. **5**, a stop command is issued in the middle of the coating work at the planned coating position A**2**. Even in such a case, as shown in FIG. **5**, the discharge pressure Pd and opening action of the nozzle **14** relating to the planned coating position A**2** are maintained until the predetermined coating work ends. Further, if such coating work ends, at step S**19**, the discharge pressure Pd of the pump is released.

In this way, in the present invention, even when a stop command of the robot **11** has been issued, the pump is made to stop after the coating work at the corresponding planned coating position A**2** has ended. Therefore, the amount of coating of the viscous material does not change from the intended coating amount. Consequently, it is possible to obtain a coating amount at the planned coating position A**2** similar to the amount of coating at the planned coating position A**1**. In the present invention, the selection unit **26** is provided, so it becomes possible to select the post-coating stopping unit **24** or immediate stopping unit **25** in accordance with the content of coating.

In this regard, when it is judged at step S**13** that the stop command issuing unit **28** has issued a stop command of the robot **11**, the stop command causes the robot **11** to shift to a stop operation and coast. Therefore, as shown in FIG. **5**, the speed of the robot **11** gradually falls and finally becomes zero. The position at which the robot **11** stops is called the "robot stop position".

Then, at step S**20**, it is judged that the robot stop position has passed the coating start position of the next planned coating position. When not passing the coating start position, the routine proceeds to step S**16**. As opposed to this, when passing the coating start position, the routine proceeds to step S**20**. At step S**20**, the robot is retracted and the robot stop position is returned to at least the coating start position of the next planned coating position.

In FIG. **5**, while a stop command is issued in the middle of the coating work at the planned coating position A**2**, the coating work at the planned coating position A**2** is continued and then ended. However, as can be seen from FIG. **5**, the robot stop position at this time is at a location where the planned coating position A**3** passes. For this reason, if resuming the operation of the robot **11** from the robot stop position, the coating work at the planned coating position A**3** is skipped.

For this reason, in the present invention, the robot retracting unit **27** is used to make the robot **11** move to at least the coating start position of the planned coating position A**3** along the coating path. In FIG. **5**, the coating start position corresponds to the pilot pressure Pr start position at the planned coating position A**3**. However, it is also possible to employ a position further upstream from this position as the coating start position. In this way, in the present invention, at the time of scatter coating, it is possible to prevent coating work at part of the planned coating positions from being skipped.

In this regard, FIG. **6** is a view which shows a time chart of the pump pressure, nozzle, robot speed, and coating path at the time of resuming coating work. As explained referring to FIG. **5**, after the robot **11** is made to move to the coating start position of the planned coating position A**3**, the speed of the robot is raised from zero and, as shown in FIG. **6**, the pump **13** and nozzle **14** are driven. Due to this, the planned coating

positions A3, A4 can also be coated with the viscous material by a coating amount similar to the planned coating positions A1, A2.

FIG. **7** is a schematic side view of a robot coating system according to a second embodiment of the present invention. As can be seen from FIG. **7**, in the second embodiment, a coating work controller **16** is arranged between the robot controller **10** and the coating gun **12**. The coating work control device **16** controls the coating gun **12**, so the additional robot shaft **17** is eliminated in the second embodiment.

Furthermore, FIG. **8** is a functional block diagram of the robot coating system which is shown in FIG. **7**. As can be seen from FIG. **8**, the robot controller **10** is not provided with a pump control unit **32**. Therefore, if a post-coating stop command B is issued to the pump **13**, the command is supplied to the coating work control device **16** through the I/O control unit **33**. Further, the coating work control device **16** supplies a post-coating stop command B to the pump drive motor **36** and nozzle opening unit **37**. Therefore, in the second embodiment as well, even if a stop command is issued in the middle of the coating work, the coating work is continued until the coating work at the corresponding planned coating position A ends. For this reason, it will be understood that similar effects are obtained as explained above.

Further, FIG. **9** is a schematic side view of a robot coating system according to a third embodiment of the present invention. The functional block diagram of the robot coating system in the third embodiment is generally similar to those which is shown in FIG. **8**. In the third embodiment, the workpiece W is attached to the front end of the robot **11** or is held by the hand of the robot **11**. Further, the coating gun **12** is supported by the coating gun support **19**.

In the third embodiment, the robot moving unit **21** makes the robot **11** which holds the workpiece W move so that the front end of the nozzle **14** is successively positioned at a plurality of planned coating positions on the workpiece W. In this way, even if the coating gun **12** is supported by the coating gun support **19** and the robot **11** makes the workpiece W move, it is clear to a person skilled in the art that effects similar to the above are obtained.

In this regard, FIG. **10** is a view which shows the coating conditions which are displayed on the teaching panel **15**. FIG. **10** shows a first coating condition. At the coating conditions #**1**, the flow rate of the viscous material at the time of coating is set to 1 cc/sec, the coating time corresponding to the opening time of the nozzle **14** is set to 50 msec, the ratio of the pilot pressure Pr with respect to the discharge pressure Pd, that is, the pilot pressure rate, is set to 50%, and the pilot pressure time during which the pilot pressure Pr is maintained set to 50 msec.

Further, FIG. **11** is a view which shows part of a coating program which is displayed on a teaching panel. The "position" which is shown in FIG. **11** shows one planned coating position. Further, the "SS" of FIG. **11** is an abbreviation for "Sealing Start", while "SS[1]" means the start of coating of the sealing material as a viscous material. Furthermore, the "smooth" of FIG. **11** means the robot **11** is made to operate smoothly.

Part of the coating conditions and coating program is displayed on the teaching panel **15**. Further, the operator refers to the display content while using the teaching panel **15** to teach the robot coating system **1**. The teaching panel **15** displays the coating time of the viscous material (nozzle opening time) (FIG. **10**) and the planned coating position (FIG. **11**). Therefore, it will be understood that the operator can refer to the teaching panel **15** to easily and simply perform the teaching work for scatter coating.

ADVANTAGEOUS EFFECTS OF INVENTION

In the first aspect, even if a stop command of the robot is issued, the pump is made to stop after the coating work at the corresponding planned coating position ends. Therefore, even if the coating work of scatter coating is interrupted and then the coating work is resumed, the amount of coating of the viscous material will not change from the intended coating amount. Therefore, it is possible to coat a coating amount similar to the coating amount at another planned coating position.

In the second aspect, either the post-coating stopping unit and the immediate stopping unit can be selected. Therefore, when scatter coating the viscous material, the post-coating stopping unit is selected, while when coating the viscous material by a straight continuous path, the immediate stopping unit is selected. That is, selection in accordance with the content of the coating work becomes possible.

In the third aspect, even if the robot passes the coating start position before the robot completely stops after a robot stop command is issued, the robot can be returned to the coating start position. For this reason, at the time of scatter coating, it is possible to prevent coating work at part of the planned coating positions from being skipped.

In the fourth aspect, at least the planned coating position and coating time is displayed. Therefore, it is possible for an operator to easily and simply perform teaching work for scatter coating.

Typical embodiments were used to explain the present invention, but it will be understood that a person skilled in the art could make the above-mentioned changes and various other changes, deletions, and additions without departing from the scope of the present invention.

The invention claimed is:

1. A robot coating system which includes a robot which is provided with a coating gun which uses a pump to coat a viscous material and in which said coating gun coats a plurality of planned coating positions of a workpiece with said viscous material in exactly predetermined amounts to thereby scatter coat the viscous material, the robot coating system comprising:

a robot moving unit configured to make said robot which is provided with said coating gun successively move to said plurality of planned coating positions at the time of operation of said robot coating system,

a pilot pressure imparting unit configured to make said pump of the coating gun before reaching said planned coating positions and imparts to said viscous material a predetermined pilot pressure without coating said viscous material,

a coating executing unit configured to execute coating work of said viscous material by a predetermined flow rate over a predetermined coating time when said coating gun has reached a planned coating position or immediately before that,

a post-coating stopping unit configured to continue said coating work by said coating executing unit and make said pump stop after the end of said coating work when said coating executing unit is executing said coating work and a first command is issued to stop said robot,

an immediate stopping unit configured to make said pump stop without continuing said coating work by said coating executing unit when said coating executing unit is executing said coating work and a second command is issued to stop said robot, and

a selection unit configured to execute one of said post-coating stopping unit and said immediate stopping unit for functioning.

2. The robot coating system as set forth in claim **1**, further comprising a robot retracting unit configured to make said robot retract to at least said coating start position when a stop command of said robot is issued and said robot stops over the coating start position of said planned coating position before coating said viscous material at one planned coating position among said plurality of planned coating positions.

3. The robot coating system as set forth in claim **1**, further comprising

an input unit which teaches coating conditions of said coating work and

a display unit which displays at least one coating condition which is taught from said input unit including a coating time and flowrate of said viscous material and at least one planned coating position.

4. The robot coating system as set forth in claim **2**, further comprising

an input unit which teaches coating conditions of said coating work and

a display unit which displays at least one coating condition which is taught from said input unit including a coating time and flow rate of said viscous material and at least one planned coating position.

* * * * *